PATENT ABSTRACTS OF JAPAN

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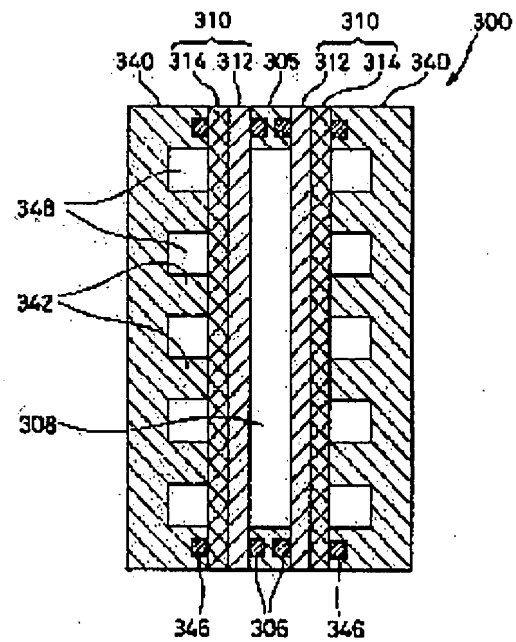
(54) HUMIDIFYING DEVICE FOR FUEL CELL

(57)Abstract:

PURPOSE: To properly control a humidifying quantity of fuel gas.

CONSTITUTION: A fuel gas humidifying layer 300 is constituted of a water permeable layer 310 and a gas flow path structure 340. The water permeable layer 310 comprises a film-shaped microporous film 312 made of polypropyrene to have many holes of 10-8 to 10-7 bore size and a hydrophilic layer 314 formed by laminating nonwoven fabric in a surface of this microporous film 312. In the microporous film 312, water is permeated in accordance with a pressure difference between both sides bordering the film. In the hydrophilic layer 314, a contact area between water and fuel gas is increased, to improve humidifying ability. As a result, by changing a difference between a pressure in a water flow path 308 and a pressure in a fuel gas flow path 348, an amount of water permeated through the water permeable layer 310 can be adjusted, and a humidifying quantity of fuel gas can be properly controlled.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the humidification equipment which humidifies the fuel gas supplied to the electrode of a fuel cell in detail about the humidification equipment of a fuel cell.
[0002]
[Description of the Prior Art] In a polymer electrolyte fuel cell, as shown in a degree type, in cathode, the reaction for which the reaction which uses hydrogen gas as a hydrogen ion and an electron generates an electron to oxygen gas, a hydrogen ion, and water in an anode plate is performed.
[0003]
cathode reaction: -- H2 ->2H++2e-anodic reaction: -- 2H -- ++2e-+(1/2) O2 ->H2O [0004] The hydrogen ion generated in cathode will be in a hydration condition (H+andxH2O), and will move the inside of an electrolyte membrane to an anode plate. For this reason, near the cathode side front face of an electrolyte membrane, in order to be in the condition that water runs short and to perform an above-mentioned reaction continuously, it is necessary to supply this water running short. Although the electrolyte membrane used for a polymer electrolyte fuel cell has good electrical conductivity by the damp or wet condition, if water content falls, the electric resistance of an electrolyte membrane will become large, and it stops fully functioning as an electrolyte, and will stop electrode reaction depending on the case.
[0005] As for supply of this water, it is common to carry out by humidifying fuel gas. The equipment which carries out bubbling of the fuel gas and humidifies it as equipment which humidifies fuel gas, the equipment (for example, JP,5-54900,A) which sprays pressurization water directly on fuel gas, and humidifies it to it, the equipment (for example, JP,3-20971,A) which humidifies fuel gas through the gaseous-diffusion film which penetrates a steam, the equipment (for example, JP,3-269958,A) which humidifies fuel gas through the porous membrane made of tetrafluoroethylene resin are proposed.
[0006]
[Problem(s) to be Solved by the Invention] However, with these humidification equipments, there was a problem that the amount (the amount of humidification) of the water which each humidifies was easily [proper and] uncontrollable. With the humidified equipment which carries out bubbling, the amount of humidification becomes settled by the temperature of fuel gas, the contact time of fuel gas and water, etc., and the desired amount of humidification does not become to the amount of fuel gas. Although the amount of humidification is controllable by controlling the injection quantity with the equipment which sprays pressurization water directly on fuel gas, and humidifies it to it, a spraying condition changes with the conditions of a spraying nozzle, and the case where a foreign matter is occasionally got blocked in a spraying nozzle, and it cannot humidify is produced. With the equipment humidified using the gaseous diffusion film, the water of the liquid phase cannot be used, but in order to consider as a steam, water must be heated. It is the structure where the water of the liquid phase is supplied from the porous body by which only the amount of the water evaporated on porous membrane adjoined porous membrane with the humidification equipment using the porous membrane made of tetrafluoroethylene resin, and it is difficult to adjust or set up the amount of water supplied with a sufficient precision.
[0007] With such conventional equipment that cannot adjust the amount of humidification, fuel gas may be humidified superfluously, in this case, a steam dews on an electrode, an electrode is wet, supply of the fuel gas to an electrode is barred, and the problem of reducing the engine performance of a fuel cell is also produced.
[0008] The humidification equipment of the fuel cell of this invention solved such a problem, was made for the purpose of controlling the amount of humidification proper and easily, and took the next configuration.
[0009]
[Means for Solving the Problem] The humidification equipment of the fuel cell of this invention is

humidification equipment which humidifies the fuel gas supplied to the electrode of a fuel cell, touches the passage of said fuel gas, and the passage of water, and makes it a summary to have had the porous film which penetrates this water according to the differential pressure of this fuel gas and this water, and the differential pressure adjustment device which sets up or adjusts said differential pressure.

[0010] Here, in said humidification equipment, said porous film can also be considered as the configuration which is the polyolefine system (CnH2n) resin film which has many ten to 8 m diameters thru/or holes of ten to 7 m. Moreover, in said humidification equipment, it is prepared in the passage side of said fuel gas of said porous film, and can also consider as the configuration equipped with the hydrophilic layer which makes this fuel gas evaporate the water which penetrated this porous film. This hydrophilic layer can also be considered as the configuration which is the nonwoven fabric laminated on said porous film.

[0011]

[Function] The humidification equipment of the fuel cell of this invention constituted as mentioned above penetrates water according to the differential pressure of the fuel gas and water to which the porous film was set up or adjusted with the differential pressure adjustment device. Transmitted water is evaporated, serves as a steam and is mixed with fuel gas. Consequently, adjustment of the amount of water which penetrates the porous film is attained, as a result adjustment of the amount of humidification of fuel gas is attained.

[0012] Here, the touch area of humidification equipment equipped with the hydrophilic layer which makes fuel gas evaporate the water which penetrated the porous film to the passage side of the fuel gas of the porous film then fuel gas, and water becomes large, and humidification capacity increases. The nonwoven fabric which laminated the hydrophilic layer on the porous film especially, then manufacture also become easy.

[0013]

[Example] In order to clarify further a configuration and an operation of this invention explained above, the suitable example of this invention is explained below. Drawing 1 is the mimetic diagram which illustrated the outline configuration of the polymer electrolyte fuel cell 10 which applied the example of the humidification equipment of the fuel cell of this invention. A polymer electrolyte fuel cell 10 is equipped with the generation-of-electrical-energy zone 20 which comes to carry out two or more laminatings of the cel 100 and the cooling water passage 200 of a cell in the thickness direction, the humidification zone 30 which consists of an oxygen content gas humidification layer 400 which humidifies the hydrogen gas humidification layer 300 and oxygen content gas which humidify hydrogen gas, and the control unit 800 which controls the amount of humidification of hydrogen gas by the hydrogen gas humidification layer 30.

[0014] A cel 100 like drawing 2 which illustrated the outline of the structure An electrolyte membrane 110, The anode plate 120 and cathode 130 which are made into sandwich structure on both sides of this electrolyte 110 from both sides, The collectors 140 and 150 which form the passage of an anode plate side fuel and a cathode side fuel in an anode plate 120 and cathode 130 while inserting this sandwich structure from both sides, It is constituted by the separator 160 which makes the septum at the time of having been arranged on the outside of collectors 140 and 150, and carrying out the laminating of the cel 100.

[0015] An electrolyte membrane 110 is the ion exchange membrane formed by polymeric materials, for example, fluororesin, and shows good electric conductivity according to a damp or wet condition. An anode plate 120 and cathode 130 are formed of the carbon cross woven with the yarn which consists of a carbon fiber, and the carbon powder which supported the alloy which becomes this carbon cross from the platinum as a catalyst or platinum, and other metals is scoured in the clearance between crosses. The porosity in which collectors 140 and 150 have gas permeability by porosity is formed with 40 thru/or 80% of porous carbon. A collector 140 forms the oxygen gas passage 148 which makes the catchment way of the water generated in an anode plate 120 while making the passage of the oxygen content gas of an anode plate fuel on the front face of an anode plate 120. Moreover, a collector 150 forms the hydrogen gas passageway 158 which makes the passage of the mixed gas of the hydrogen gas of a cathode fuel, and a steam on the front face of cathode 130. The separator 160 is formed with gas the non-penetrated carbon which compressed carbon and it presupposed gas un-penetrating, and makes the septum at the time of carrying out the laminating of the cel constituted with an electrolyte membrane 110, electrodes 120 and 130, and collectors 140 and 150 in the thickness direction.

[0016] The hydrogen gas humidification layer 300 like drawing 3 which illustrated the outline of the structure The water passage structure 305 which forms the central layer of the hydrogen gas humidification layer 300, and the water transparency layer 310 which penetrates the water of the water passage 308 while arranging on both sides of the water passage structure 305 and forming the water passage 308 by the water passage structure 305, While being arranged on the outside of the water transparency layer 310 and making the outer layer of the hydrogen gas humidification layer 300, water transparency layers 310 are consisted of by the gas-passageway structure 340 which forms the hydrogen gas passageway 348. Below, it explains in more detail.

[0017] The water passage structure 305 is formed with gas the non-penetrated carbon which compressed carbon

and it presupposed gas un-penetrating. The water passage structure 305 is carrying out the frame configuration of predetermined thickness, and forms the water passage 308 by inserting the both sides of the thickness direction in the water transparency layer 310. This water passage 308 is watertight by carrying out the seal of the water passage structure 305 and the water transparency layer 310 by the seal member 306. In addition, to water, although the water passage structure 305 was formed with gas non-penetrated carbon in the example, as long as it is the stable quality of the material, you may form according to what kind of the quality of the material.

[0018] The water transparency layer 310 consists of a hydrophilic layer 314 laminated by the product made from polypropylene on the front face by the side of an aperture 10-8 thru/or the 10 gas-passageway structure 340 of the micro porous film 312 of the shape of a film which has many holes of -7, and this micro porous film 312.

[0019] The micro porous film 312 penetrates water according to the differential pressure of the both sides bordering on a film. The graph showing an example of the relation between the pressure which acts on the micro porous film 312, and the amount of water which penetrates the micro porous film 312 is shown in drawing 4 . Among drawing, a straight line A is the property that a micro porous film with the 0.25x0.075 micrometers of the maximum apertures, a% [of void contents] of 45, and a thickness of 25 micrometers shows the front face when hydrophilic processing is carried out by the surfactant, and a straight line B is the property that a micro porous film with the 0.125x0.05 micrometers of the maximum apertures, a% [of void contents] of 38, and a thickness of 25 micrometers shows the front face when hydrophilic processing is carried out by the surfactant. The amount of the water which penetrates this film becomes settled to the differential pressure of the fuel gas and water which act on the both sides of a micro porous film according to the surface state of the aperture of a micro porous film, a void content, thickness, and a film. The micro porous film 312 can come to hand as a trade name "Celgard" from Daicel Chemical Industries.

[0020] The hydrophilic layer 314 consists of a nonwoven fabric made from polypropylene, enlarges the touch area of the water and hydrogen gas which penetrated the micro porous film 312, and heightens humidification capacity. In addition, although considered as the water transparency layer 310 equipped with the hydrophilic layer 314 in the example, a configuration without the hydrophilic layer 314 may be used.

[0021] The gas-passageway structure 340 is formed with gas non-penetrated carbon. Two or more heights 342 arranged in parallel are formed in the front face by the side of the water transparency layer 310 of the gas-passageway structure 340, and two or more hydrogen gas passagewaies 348 in two or more heights 342 and water transparency layers 310 are formed. Moreover, the seal of the gas-passageway structure 340 and the water transparency layer 310 is carried out by the seal member 346. In addition, although the gas-passageway structure 340 was formed with gas non-penetrated carbon in the example, as long as it is the quality of the material which is not invaded by hydrogen gas, you may form according to what kind of the quality of the material.

[0022] Moreover, the pressure gage 309 which measures the water pressure in the water passage 308, and the pressure gage 349 which measures the hydrogen gas pressure in the hydrogen gas passageway 348 are formed in the water passage 308 and the hydrogen gas passageway 348 of the hydrogen gas humidification layer 300, and the pressure gage 309 and the pressure gage 348 are connected to the control unit 800.

[0023] In this way, according to the difference of the pressure of the water with which the constituted hydrogen gas humidification layer 300 flows the water passage 308, and the pressure of the hydrogen gas which flows the hydrogen gas passageway 348, the water of the water passage 308 penetrates the micro porous film 312. This transmitted water is evaporated in hydrogen gas in the hydrophilic layer 314, and humidifies hydrogen gas.

[0024] The oxygen content gas humidification layer 400 which humidifies oxygen content gas among the fuel gas used for a polymer electrolyte fuel cell 10 is equipped with the same water passage structure 405 as the water passage structure 305, the water transparency layer 310, and the gas-passageway structure 340 which constitute the hydrogen gas humidification layer 300, the water transparency layer 410, and the gas-passageway structure 440, and has the water passage 408 and the oxygen-gas passage 448 equivalent to the water passage 408 and the hydrogen gas passageway 348 of the hydrogen gas humidification layer 300. Moreover, the water transparency layer 410 consists of a micro porous film 412 and a hydrophilic layer 414 as well as the water transparency layer 310. Therefore, according to the difference of the pressure of the water with which the oxygen content gas humidification layer 400 flows the water passage 408, and the pressure of the oxygen content gas which flows the oxygen gas passage 448, the water of the water passage 408 penetrates the micro porous film 412. This transmitted water is evaporated in oxygen content gas in the hydrophilic layer 414, and humidifies oxygen content gas.

[0025] Next, the connection condition of the passage 148 and 158 of the fuel gas of a cel 100, the cooling water passage 200, the water passage 308 of the hydrogen gas humidification layer 300 and the hydrogen gas

passageway 348, the water passage 408 of the oxygen content gas humidification layer 400, and oxygen gas passage 448 grade is explained. The inlet port of the cooling water passage 200 of the generation-of-electrical-energy zone 20 is connected to the water tank which is not illustrated through the water path 520 and a pump 500, and the outlet of the cooling water passage 200 is connected to the inlet port of the water passage 308 of the hydrogen gas humidification layer 300, and the water passage 458 of the oxygen content gas humidification layer 400 through the water path 522. Therefore, the water used as cooling water in the generation-of-electrical-energy zone 20 is supplied to the water passage 308 of the hydrogen gas humidification layer 300, and the water passage 458 of the oxygen content gas humidification layer 400. Moreover, the outlet of the water passage 308 and the water passage 458 is connected to the heat exchanger and water tank which are not illustrated through the water path 524.

[0026] Moreover, the motor 510 which carries out adjustable [of the rotational frequency of a pump 500] is formed in the pump 500. It connects with the control unit 800 and this motor 510 drives a pump 500 at a rotational frequency based on the control signal from a control unit 800. Therefore, the water pressure in the cooling water passage 200 and the water passage 308 can be adjusted by changing the rotational frequency of a pump 500.

[0027] The inlet port of the hydrogen gas passageway 348 formed in the gas-passageway structure 340 of the hydrogen gas humidification layer 300 is connected to the hydrogen gas storage tub (not shown) through the hydrogen gas passageway 620 and the blower 600, and the outlet of the hydrogen gas passageway 348 is connected to the inlet port of the hydrogen gas passageway 158 formed in the collector 150 of a cel 100 through the hydrogen gas passageway 622. Therefore, the mixed gas of hydrogen gas and a steam flows into the hydrogen gas passageway 158. Moreover, the outlet of the hydrogen gas passageway 158 is connected to the hydrogen gas recovery tub (not shown) through the hydrogen gas passageway 624.

[0028] The inlet port of the oxygen gas passage 448 formed in the gas-passageway structure 440 of the oxygen content gas humidification layer 400 is connected to the blower 700 through the oxygen gas path 720, and the outlet of the oxygen gas passage 448 is connected to the inlet port of the oxygen gas passage 148 formed in the collector 140 of a cel 100 through the oxygen gas path 722. Therefore, the mixed gas of oxygen content gas and a steam flows into the oxygen gas passage 148. Moreover, the outlet of the oxygen gas passage 148 is connected with external atmospheric air through the oxygen gas path 724.

[0029] A control unit 800 is constituted as a logical circuit centering on a microcomputer. In detail Although various data processing is performed by CPU810 and CPU810 which perform a predetermined operation etc. according to the control program set up beforehand ROM820 in which a required control program, required control data, etc. were stored beforehand, and although various data processing is similarly performed by CPU810 It has the input-process circuit 840 where various required data input the detecting signal from RAM830 written temporarily, a pressure gage 308, and a pressure gage 349, and the output-processing circuit 850 which outputs a control signal to a motor 510 according to the result of an operation in CPU810.

[0030] In this way, although the constituted polymer electrolyte fuel cell 10 changes chemical energy into direct electrical energy by the chemical reaction mentioned above, this chemical reaction is smoothly performed by the fuel gas humidified in the humidification zone 30.

[0031] That is, at cathode 130, the reaction for which hydrogen serves as a hydrogen ion and an electron is performed, and the produced hydrogen ion combines with the water of the cathode 130 neighborhood, will be in a hydration condition, and will move in the inside of an electrolyte membrane 110. For this reason, although water runs short near [cathode 130] an electrolyte membrane 110 if it remains as it is, this lack is supplied with the steam in the mixed gas of hydrogen gas and a steam. Consequently, an electrolyte membrane 110 will always be in a damp or wet condition, a hydrogen ion can move smoothly in the inside of an electrolyte membrane 110, and a cathode reaction is performed smoothly. In an anode plate 120, the reaction which generates water by the hydrogen ion, the electron, and oxygen is performed. The steam in oxygen content gas and the mixed gas of a steam reduces the contact resistance of an anode plate 120 and collector 140 grade while securing the damp or wet condition of the electrolyte membrane 110 immediately after a start up.

[0032] Next, control of the amount of humidification in the hydrogen gas humidification layer 300 is explained based on drawing 5 . Drawing 5 is the flow chart which illustrated the differential pressure control routine performed by CPU810 of a control device 800. This differential pressure control routine is memorized by ROM820, and after a polymer electrolyte fuel cell 10 is operated, it is performed for every (every [for example,] 10msec(s)) predetermined time.

[0033] If this routine is performed, CPU810 will first read the water pressure Pw measured by the pressure gage 309, and the hydrogen gas pressure Ph measured by the pressure gage 349 through the input-process circuit 840 (step S100). Next, based on amount of humidification W* which a polymer electrolyte fuel cell 10 requires, setting differential pressure **Pset of water pressure and hydrogen gas pressure is defined (step S110). Amount

of humidification W* is called for according to the operational status of a polymer electrolyte fuel cell 10 etc. Then, hydrogen gas pressure Ph is subtracted from the water pressure Pw read at step S100, and it asks for differential pressure **P (step S120), and compares with the absolute value of the difference of this differential pressure **P and setting differential pressure **Pset, and a threshold Pref (step S130). Here, a threshold Pref is the maximum of the differential pressure by which differential pressure **P is permitted from setting differential pressure **Pset. This threshold Pref is defined by the minimum value which can control the rotational frequency of a pump 500.

[0034] When the absolute value of the difference of differential pressure **P and setting differential pressure **Pset is below the threshold Pref, it judges that it is suitable differential pressure to obtain the proper amount of humidification, and this routine is ended. When larger than a threshold Pref, the difference of differential pressure **P and setting differential pressure **Pset is multiplied by the control gain K, it asks for amount of rotational frequency increase and decrease **F (step S140), a control signal is outputted to a motor 510 through the output-processing circuit 850 from CPU810, and only amount of rotational frequency increase and decrease **F makes the rotational frequency of a pump 500 fluctuate (step S150). In this way, differential pressure **P of water pressure Pw and hydrogen gas pressure Ph is set to setting differential pressure **Pset, and it considers as the proper amount of humidification.

[0035] Next, the property of a polymer electrolyte fuel cell 10 is explained using an example. Drawing 6 is the graph which illustrated an example of the relation between the current density of a polymer electrolyte fuel cell 10, and an electrical potential difference. The curves C in drawing are operational characteristics which the following polymer electrolyte fuel cell 10 shows. The generation-of-electrical-energy zone 20 of this polymer electrolyte fuel cell 10 sticks by pressure the anode plate 120 and cathode 130 of a carbon cross which supported platinum 0.4 mg/cm2 to an electrolyte membrane 110 by hot pressing, using the Du Pont Nafion film (trade name) as an electrolyte membrane 110, carries out 50 cel laminating of the cel 100 formed as 2 144cm of electrode surface products, and is constituted. Moreover, the humidification zone 30 laminates the nonwoven fabric made from polypropylene on the micro porous film 312 with the property of the straight line A of drawing 4 , and is constituted by the hydrogen gas humidification layer 300 and the oxygen content gas humidification layer 400 using the water transparency layer 310,410 formed as 2 a transparency area of 144cm. Both the pressure of hydrogen gas and the pressure of oxygen content gas of the service condition of fuel gas and cooling water are 2kg/cm2, and the pressure of cooling water is 2.2kg/cm2.

[0036] 0.2kg/cm2 of things which can be acquired for sufficient make up water which is the difference of the pressure of fuel gas and the pressure of cooling water is meant even if it operates a polymer electrolyte fuel cell 10 by current density 1 A/cm2. Namely, in order to operate this polymer electrolyte fuel cell 10 by current density 1 A/cm2, as for hydrogen gas, 65l. / min is needed as 50l. of theoretical flow rates, min, and a SUTOIKI ratio 1.3. In this case, if it assumes that the water of 0.2 molecules runs short to one hydrogen ion in consideration of the water which a hydrogen ion moves in the condition of having hydrated with the water of three molecules in the inside of an electrolyte membrane 110, and is generated in an anode plate 120 being spread into an electrolyte membrane 110, the amount of water which runs short with an electrolyte membrane 110 will serve as about 22 g/min, and will serve as 0.08 g/min that it converts into per [an unit area (1cm2)]. The pressure of the micro porous film 312 which obtains this transparency flow rate is called for with 0.19kg/cm2 from the straight line A of drawing 4 . Therefore, even if 0.2kg/cm2 of differential pressure operates a polymer electrolyte fuel cell 10 by current density 1 A/cm2, it is the value which can supply sufficient water.

[0037] The curves D in drawing are operational characteristics shown when the polymer electrolyte fuel cell 10 in which the property of Curve C is shown, and the polymer electrolyte fuel cell with which only the water transparency layers 310 differ operate by the service condition of the same fuel gas and cooling water. The water transparency layer 310 of this polymer electrolyte fuel cell consists of only micro porous films 312, and there is not. [of 314 hydrophilic layer] Moreover, it is the configuration as the generation-of-electrical-energy zone 20 of the polymer electrolyte fuel cell 10 in which the property of Curve C is shown with the same curve E in drawing, and the polymer electrolyte fuel cells using the humidification equipment which replaces with the humidification zone 30 of a polymer electrolyte fuel cell 10, and carries out bubbling of hydrogen gas and the oxygen content gas are the operational characteristics shown when it operates on the same conditions as Curve C.

[0038] As compared with the polymer electrolyte fuel cell (curve E) humidified by bubbling, the polymer electrolyte fuel cell (Curve C and Curve D) using the water transparency layer 310 has small internal resistance in all the fields of current density, and shows a high electrical potential difference so that it may illustrate. A high current density field shows a remarkable difference especially. The polymer electrolyte fuel cell 10 (curve C) using the water transparency layer 310 equipped with the hydrophilic layer 314 shows a high electrical

potential difference in all the fields of current density as compared with the polymer electrolyte fuel cell (curve D) using the water transparency layer 310 without the hydrophilic layer 314 only with the micro porous film 312.

[0039] In the polymer electrolyte fuel cell 10 explained above, since the micro porous film 312 was used for the water transparency layer 310, the water of the liquid phase can be penetrated, and fuel gas can be humidified. Moreover, since the water permeate flow of the micro porous film 312 becomes settled according to the difference of the pressure of the fuel gas which acts on the micro porous film 312, and the pressure of water, it can control the amount of humidification easily by adjusting differential pressure. Therefore, it is also possible to control differential pressure according to the operational status of a polymer electrolyte fuel cell 10, and to control the amount of humidification.

[0040] Moreover, since the nonwoven fabric made from polypropylene was laminated on the front face of the micro porous film 312 and the hydrophilic layer 314 was formed in it, the touch area of fuel gas and water can be enlarged and humidification capacity can be heightened. Consequently, the humidification zone 30 can be miniaturized. furthermore -- being simple in the structure of a polymer electrolyte fuel cell 10, since the cooling water of a polymer electrolyte fuel cell 10 was used for the water which humidifies fuel gas -- it can carry out -- a miniaturization -- and it can low-cost-ize. Thus, it will become effective as a miniaturization and a cell carried in mobiles, such as an automobile, since it can be made simple about a polymer electrolyte fuel cell.

[0041] In addition, although considered as the generation-of-electrical-energy zone 20 of a solid-state macromolecule mold fuel cell proper, and one by making humidification equipment into the humidification zone 30 in this example, the configuration used as a solid-state macromolecule mold fuel cell proper and another object is also suitable. Moreover, although the cooling water of the generation-of-electrical-energy zone 20 was used for the water which humidifies fuel gas in the example, the configuration using the water only for humidification does not interfere, either. Furthermore, although the hydrogen gas humidification layer 300 and the oxygen content gas humidification layer 400 were formed in humidifying fuel gas and the passage of water was formed in each in the example, the configuration which made one side of the passage formed of the two gas-passageway structures which face across the passage of water the passage of hydrogen gas, and made another side the passage of oxygen gas is also suitable. From the first, the generation-of-electrical-energy zone 20 which consists of a cel 100 and cooling water passage 200 may be arrangement of what kind of number of laminatings, and the cooling water passage 200.

[0042] Moreover, in this example, although hydrogen gas was supplied to the polymer electrolyte fuel cell 10 from the hydrogen gas storage tub (not shown), the configuration which generates hydeogen-rich gas by methanol reforming etc., and is supplied to a polymer electrolyte fuel cell 10 is also suitable. In this case, inflow temperature of the hydeogen-rich gas into a polymer electrolyte fuel cell 10 is made high (for example, about 90 degrees C) a little compared with the case where the usual humidifier is used, and it is desirable to prevent that hydrogen gas temperature becomes below predetermined temperature (for example, 80 degrees C) with heat of vaporization. The temperature of the hydeogen-rich gas generated in methanol reforming is usually 200 degrees C - 300 degrees C, and from the operating temperature of a polymer electrolyte fuel cell 10, since it is quite an elevated temperature, in order to lower temperature, it is equipped with the heat exchanger etc. Therefore, the inflow temperature of hydeogen-rich gas can be adjusted by setting up laying temperature, such as this heat exchanger, more highly.

[0043] Although differential pressure **P of water pressure Pw and hydrogen gas pressure Ph was adjusted by changing the engine speed of a pump 500 in this example, the configuration adjusted by changing the engine speed of the configuration and pump 500 which are adjusted by changing the amount of pressurization of a blower 600, and the amount of pressurization of a blower 600 is also suitable. Moreover, although the amount of humidification of oxygen content gas was considered as the configuration adjusted with adjustment of the amount of humidification of hydrogen gas in this example, the configuration adjusted independently of the amount of humidification of hydrogen gas is also suitable by adjusting the amount of pressurization of a blower 700.

[0044] Although the example of this invention was explained above, as for this invention, it is needless to say that it can carry out in the mode which becomes various within limits which are not limited to such an example at all and do not deviate from the summary of this invention.

[0045]

[Effect of the Invention] As explained above, with the humidification equipment of the fuel cell of this invention, the effectiveness that the amount of water which penetrates the porous film can be adjusted easily is done so by adjusting the difference of the pressure of the fuel gas which acts on the porous film, and the pressure of water. Therefore, fuel gas can be humidified proper.

[0046] Moreover, the touch area of humidification equipment equipped with the hydrophilic layer then fuel gas,

and water can be enlarged, and humidification capacity can be heightened. Consequently, equipment can be miniaturized.

[Translation done.]

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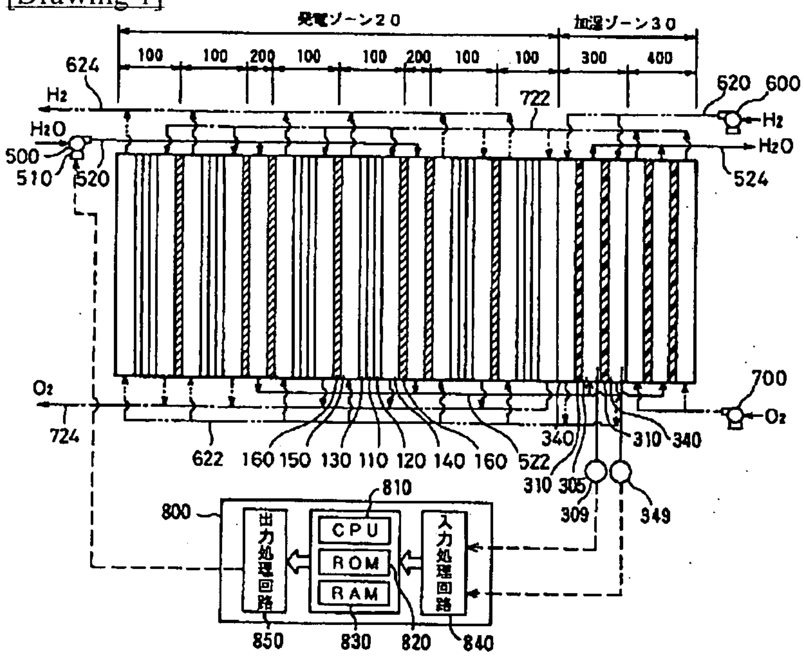
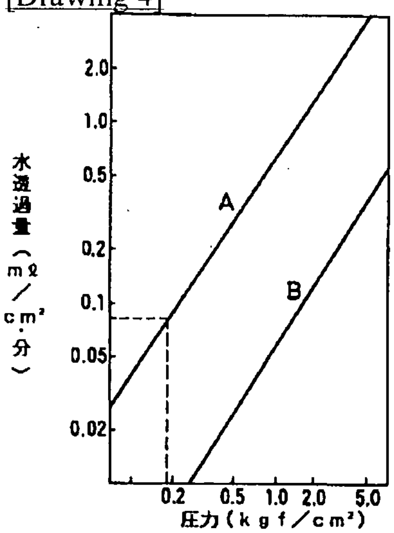
DRAWINGS

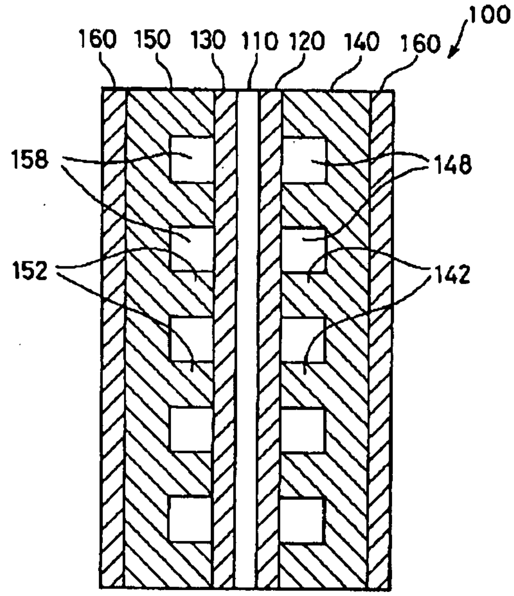
[Drawing 1]



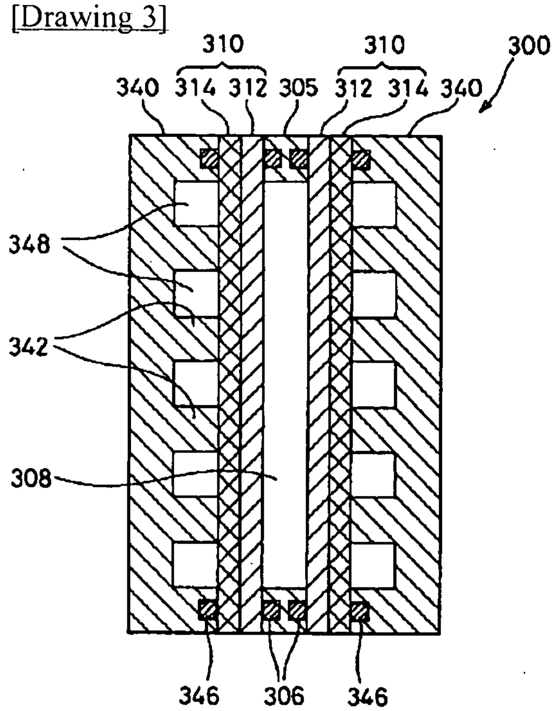
[Drawing 4]



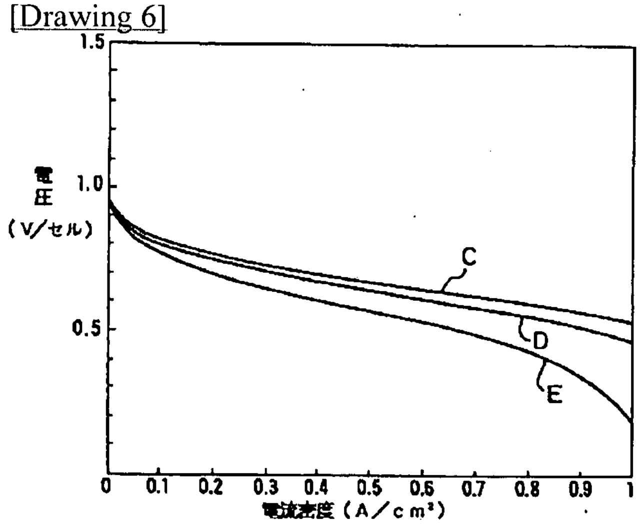
[Drawing 2]



[Drawing 3]



[Drawing 6]



[Drawing 5]